Appendix A - Tier 1 Table, Assumptions, Equations and Parameter Values

Iowa Tier 1 Look-Up Table

Media	Exposure Pathway	Receptor	Group 1				Group 2: TEH	
			Benzene	Toluene	Ethylbenzene	Xylenes	Diesel*	Waste Oil
Groundwater (ug/L)	Groundwater Ingestion	actual	5	1,000	700	10,000	1,200	400
		potential	290	7,300	3,700	73,000	75,000	40,000
	Groundwater Vapor to Enclosed Space	all	1,540	20,190	46,000	NA	2,200,000	NA
	Groundwater to Plastic Water Line	all	290	7,300	3,700	73,000	75,000	40,000
	Surface Water	all	290	1,000	3,700	73,000	75,000	40,000
Soil (mg/kg)	Soil Leaching to Groundwater	all	0.54	42	15	NA	3,800	NA
	Soil Vapor to Enclosed Space	all	1.16	48	79	NA	47,500	NA
	Soil to Plastic Water Line	all	1.8	120	43	NA	10,500	NA

NA: Not applicable. There are no limits for the chemical for the pathway, because for groundwater pathways the concentration for the designated risk would be greater than the solubility of the pure chemical in water, and for soil pathways the concentration for the designated risk would be greater than the soil concentration if pure chemical were present in the soil.
TEH: Total Extractable Hydrocarbons. The TEH value is based on risks from naphthalene, benzo(a)pyrene, benz(a)anthracene, and chrysene. Refer to Appendix B for further details.
Diesel*: Standards in the Diesel column apply to all low volatile petroleum hydorcarbons except waste oil.

Assumptions Used for Iowa Tier 1 Look-Up Table Generation

1. Groundwater ingestion pathway. The maximum contaminant levels (MCLs) were used for Group 1 chemicals. The target risk for carcinogens for actual receptors is 10^{-6} and for potential receptors is 10^{-4}. A hazard quotient of one, and residential exposure and building parameters are assumed.
2. Groundwater vapor to enclosed space pathway. Residential exposure and residential building parameters are assumed; no inhalation reference dose is used for benzene; the capillary fringe is assumed to be the source of groundwater vapor; and the hazard quotient is 1 and target risk for carcinogens is $1x10^{-4}$.
3. Groundwater to plastic water line. This pathway uses the same assumptions as the groundwater ingestion pathway for potential receptors, including a target risk for carcinogens of 10^{-4}.
4. Surface water. This pathway uses the same assumptions as the groundwater ingestion pathway for potential receptors, including a target risk for carcinogens of 10^{-4}, except for toluene which has a chronic level for aquatic life of 1,000 as in the definition for surface water criteria in 567—135.2.
5. Soil leaching to groundwater. This pathway assumes the groundwater will be protected to the same levels as the groundwater ingestion pathway for potential receptors, using residential exposure and a target risk for carcinogens of 10^{-4}.
6. Soil vapor to enclosed space pathway. The target risk for carcinogens is $1x10^{-4}$; the hazard quotient is 1; no inhalation reference dose is used for benzene; residential exposure factors are assumed; and the average of the residential and nonresidential building parameters are assumed.
7. Soil to plastic water line pathway. This pathway uses the soil leaching to groundwater model with nonresidential exposure and a target risk for carcinogens of 10^{-4}.

In addition to these assumptions, the equations and parameter values used to generate the Iowa Tier 1 Look-Up Table are described below.

Groundwater Ingestion Equations

Carcinogens:

$$RBSL_w\left[\frac{mg}{L - H_2O}\right] = \frac{TR \times BW \times AT_c \times \frac{365\ days}{year}}{SF_o \times IR_w \times EF \times ED}$$

Noncarcinogens:

$$RBSL_w\left[\frac{mg}{L - H_2O}\right] = \frac{THQ \times RfD_o \times BW \times AT_n \times \frac{365\ days}{year}}{IR_w \times EF \times ED}$$

Soil Leaching to Groundwater Equations

$$RBSL_{sl}\left[\frac{mg}{kg - soil}\right] = \frac{RBSL_w\left[\frac{mg}{L - H_2O}\right]}{LF}$$

$$LF\left[\frac{mg/L - H_2O}{mg/kg - soil}\right] = \frac{\rho_s}{(\theta_{ws} + k_s\rho_s + H\theta_{as})\left(1+\frac{U\delta}{IW}\right)}$$

Soil Vapor to Enclosed Space Equations

$$RBSL_{sv}\left[\frac{mg}{kg\text{ - }soil}\right] = \frac{RBSL_{air}\left[\frac{\mu g}{m^3\text{ - }air}\right]}{VF_{sv}}\left(\frac{mg}{1000\ \mu g}\right)$$

$$VF_{sv}\left[\frac{(mg/m^3\text{ - }air)}{(mg/kg\text{ - }soil)}\right] = \frac{\frac{H\rho_s}{(\theta_{ws} + k_s\rho_s + H\theta_{as})}\left[\frac{D_s^{eff}/L_s}{ER\ L_B}\right]}{1+\left[\frac{D_s^{eff}/L_s}{ER\ L_B}\right] + \left[\frac{D_s^{eff}/L_s}{\left(D_{crack}^{eff}/L_{crack}\right)\eta}\right]}\left(10^3\ \frac{cm^3\text{ - }kg}{m^3\text{ - }g}\right)$$

$$D_{crack}^{eff}\left[\frac{cm^2}{s}\right] = D^{air}\ \frac{\theta_{acrack}^{3.33}}{\theta_T^2} + D^{wat}\frac{1}{H}\frac{\theta_{wcrack}^{3.33}}{\theta_T^2}$$

$$D_s^{eff}\left[\frac{cm^2}{s}\right] = D^{air}\ \frac{\theta_{as}^{3.33}}{\theta_T^2} + D^{wat}\frac{1}{H}\frac{\theta_{ws}^{3.33}}{\theta_T^2}$$

Indoor Air Inhalation Equations

Carcinogens:

$$RBSL_{air}\left[\frac{\mu g}{m^3\text{ - air}}\right]=\frac{TR\times BW\times AT_c\times\frac{365\text{ days}}{\text{year}}\times\frac{1000\ \mu g}{mg}}{SF_i\times IR_{air}\times EF\times ED}$$

Noncarcinogens:

$$RBSL_{air}\left[\frac{\mu g}{m^3\text{ - air}}\right]=\frac{THQ\times RfD_i\times BW\times AT_n\times\frac{365\text{ days}}{\text{year}}\times\frac{1000\ \mu g}{mg}}{IR_{air}\times EF\times ED}$$

Groundwater Vapor to Enclosed Space Equations

$$RBSL_{gw}\left[\frac{mg}{L\text{ - }H_2O}\right]=\frac{RBSL_{air}\left[\frac{\mu g}{m^3\text{ - air}}\right]}{VF_{gw}}\left(\frac{mg}{1000\ \mu g}\right)$$

$$VF_{gw}\left[\frac{(mg/m^3\text{ - air})}{(mg/L\text{ - }H_2O)}\right]=\frac{H\left[\frac{D_s^{eff}/L_{gw}}{ER\ L_B}\right]}{1+\left[\frac{D_s^{eff}/L_{gw}}{ER\ L_B}\right]+\left[\frac{D_s^{eff}/L_{gw}}{\left(D_{crack}^{eff}/L_{crack}\right)\eta}\right]}\left(\frac{10^3 L}{m^3}\right)$$

Variable Definitions

δ	groundwater mixing zone thickness (cm)
η	areal fraction of cracks in foundation/wall (cm^2-cracks/cm^2-area)
ρ_s	soil bulk density (g/cm^3)
θ_{acrack}	volumetric air content in foundation/wall cracks (cm^3-air/cm^3-soil)
θ_{as}	volumetric air content in vadose zone (cm^3-air/cm^3-soil)
θ_T	total soil porosity (cm^3-voids/cm^3-soil)
θ_{wcrack}	volumetric water content in foundation/wall cracks (cm^3-H_2O/cm^3-soil)
θ_{ws}	volumetric water content in vadose zone (cm^3-H_2O/cm^3-soil)
AT_c	averaging time for carcinogens (years)
AT_n	averaging time for noncarcinogens (years)
BW	body weight (kg)
D^{air}	chemical diffusion coefficient in air (cm^2/s)
D^{wat}	chemical diffusion coefficient in water (cm^2/s)
D_{crack}^{eff}	effective diffusion coefficient through foundation cracks (cm^2/s)
D_s^{eff}	effective diffusion coefficient in soil based on vapor-phase concentration (cm^2/s)
ED	exposure duration (years)
EF	exposure frequency (days/year)
ER	enclosed space air exchange rate (s^{-1})
f_{oc}	fraction organic carbon in the soil (kg-C/kg-soil)
H	henry's law constant (L-H_2O)/(L-air)
i	groundwater head gradient (cm/cm)
I	infiltration rate of water through soil (cm/year)
IR_{air}	daily indoor inhalation rate (m^3/day)
IR_w	daily water ingestion rate (L/day)
K	hydraulic conductivity (cm/year)
K_{oc}	carbon-water sorption coefficient (L-H_2O/kg-C)
k_s	soil-water sorption coefficient (L-H_2O/kg-soil), f_{oc} x K_{oc}
L_B	enclosed space volume/infiltration area ratio (cm)
L_{crack}	enclosed space foundation or wall thickness (cm)
LF	leaching factor from soil to groundwater ((mg/L-H_2O)/(mg/kg-soil))
L_{gw}	depth to groundwater from the enclosed space foundation (cm)
L_s	depth to subsurface soil sources from the enclosed space foundation (cm)
$RBSL_{air}$	Risk-Based Screening Level for indoor air ($\mu g/m^3$-air)
$RBSL_{gw}$	Risk-Based Screening Level for vapor from groundwater to enclosed space air inhalation (mg/L-H_2O)
$RBSL_{sl}$	Risk-Based Screening Level for soil leaching to groundwater (mg/kg-soil)
$RBSLs_v$	Risk-Based Screening Level for vapors from soil to enclosed space air inhalation (mg/kg-soil)
$RBSL_w$	Risk-Based Screening Level for groundwater ingestion (mg/L-H_2O)
RfD_i	inhalation chronic reference dose ((mg/(kg-day))
RfD_o	oral chronic reference dose ((mg/(kg-day))
SF_i	inhalation cancer slope factor ((kg-day)/mg)
SF_o	oral cancer slope factor ((kg-day)/mg)
THQ	target hazard quotient for individual constituents (unitless)
TR	target excess individual lifetime cancer risk (unitless)
U	groundwater Darcy velocity (cm/year), U=Ki
VF_{gw}	volatilization factor for vapors from groundwater to enclosed space ((mg/m^3-air)/(mg/L-H_2O))
VF_{sv}	volatilization factor for vapors from soil to enclosed space ((mg/m^3-air)/(mg/kg-soil))
W	width of soil source area parallel to groundwater flow direction (cm)

Soil and Groundwater Parameter Values Used for Iowa Tier 1 Table Generation

Parameter		Iowa Tier 1 Table Value
K	hydraulic conductivity	16060 cm/year
i	groundwater head gradient	0.01 cm/cm
W	width of soil source area parallel to groundwater flow direction	1500 cm
I	infiltration rate of water through soil	7 cm/year
δ	groundwater mixing zone thickness	200 cm
ρ_s	soil bulk density	1.86 g/cm^3
θ_{as}	volumetric air content in vadose zone	0.2 cm^3-air/cm^3-soil
θ_{ws}	volumetric water content in vadose zone	0.1 cm^3-H_2O/cm^3-soil
θ_{acrack}	volumetric air content in foundation/wall cracks	0.2 cm^3-air/cm^3-soil
θ_{wcrack}	volumetric water content in foundation/wall cracks	0.1 cm^3-H_2O/cm^3-soil
θ_T	total soil porosity	0.3 cm^3-voids/cm^3-soil
f_{oc}	fraction organic carbon in the soil	0.01 kg-C/kg-soil
L_s	depth to subsurface soil sources from the enclosed space foundation	1 cm
L_{gw}	depth to groundwater from the enclosed space foundation	1 cm

Exposure Factors Used in Iowa Tier 1 Table Generation

Parameter		Residential	Nonresidential
AT_c (years)	averaging time for carcinogens	70	70
AT_n (years)	averaging time for noncarcinogens	30	25
BW (kg)	body weight	70	70
ED (years)	exposure duration	30	25
EF (days/year)	exposure frequency	350	250
IR_{air} (m^3/day)	daily indoor inhalation rate	15	20
IR_w (L/day)	daily water ingestion rate	2	1
THQ (unitless)	target hazard quotient for individual constituents	1.0	1.0

Building Parameters Used in Iowa Tier 1 Table Generation

Parameter		Residential	Nonresidential
ER (s^{-1})	enclosed space air exchange rate	0.00014	0.00023
L_B (cm)	enclosed space volume/infiltration area ratio	200	300
L_{crack} (cm)	enclosed space foundation or wall thickness	15	15
η	areal fraction of cracks in foundation/wall	0.01	0.01

Chemical-Specific Parameter Values Used for Iowa Tier 1 Table Generation

Chemical	D^{air} (cm^2/s)	D^{wat} (cm^2/s)	H (L-air/L-water)	log(K_{oc}), L/kg
Benzene	0.093	1.1e-5	0.22	1.58
Toluene	0.085	9.4e-6	0.26	2.13
Ethylbenzene	0.076	8.5e-6	0.32	1.98
Xylenes	0.072	8.5e-6	0.29	2.38
Naphthalene	0.072	9.4e-6	0.049	3.11
Benzo(a)pyrene	0.050	5.8e-6	5.8e-8	5.59
Benz(a)anthracene	0.05	9.0e-6	5.74e-7	6.14
Chrysene	0.025	6.2e-6	4.9e-7	5.30

Saturation Values Used to Determine "NA" for the Iowa Tier 1 Table

Chemical	Solubility in Water (mg/L) S	Saturation in Soil (mg/kg) C_s^{sat}
Benzene	1,750	801
Toluene	535	765
Ethylbenzene	152	159
Xylenes	198	492
Naphthalene	31	401
Benzo(a)pyrene	0.0012	4.69
Benz(a)anthracene	0.014	193.3
Chrysene	0.0028	5.59

The maximum solubility of the pure chemical in water is listed in the table above. The equation below is used to calculate the soil concentration (C_s^{sat}) at which dissolved pore-water and vapor phases become saturated. Tier 1 default values are used in the equation. "NA" (for not applicable) is used in the Tier 1 table when the risk-based value exceeds maximum solubility for water (S) or maximum saturation for soil (C_s^{sat}).

$$C_s^{sat}(\text{mg/kg-soil}) = S/\rho_s \times (H\theta_{as} + \theta_{ws} + k_s\, \rho_s)$$

Slope Factors and Reference Doses Used for Iowa Tier 1 Table Generation

Chemical	SF_i ((kg-day)/mg)	SF_o ((kg-day)/mg)	RfD_i (mg/(kg-day))	RfD_o (mg/(kg-day))
Benzene	0.029	0.029	----	----
Toluene	----	----	0.114	0.2
Ethylbenzene	----	----	0.286	0.1
Xylenes	----	----	2.0	2.0
Naphthalene	----	----	0.004	0.004
Benzo(a)pyrene	6.1	7.3	----	----
Benz(a)anthracene	0.61	0.73	----	----
Chrysene	0.061	0.073	----	----

Appendix B - Tier 2 Equations and Parameter Values

All Tier 1 equations and parameters apply at Tier 2 except as specified below.

Equation for Tier 2 Groundwater Contaminant Transport Model

$$C(x) = C_s \exp\left(\frac{x}{2\alpha}\left[1- \sqrt{1+ \frac{4\lambda\alpha_x}{}}\right]\right)\mathrm{erf}\left(\frac{S_w}{}\right)\mathrm{erf}\left(\frac{S_d}{}\right)$$

Variable definitions
x: distance in the x direction downgradient from the source
erf( ): the error function
C(x): chemical concentration in groundwater at x
C_s: Source concentration in groundwater (groundwater concentration at x=0)
S_w: width of the source (perpendicular to x)
S_d: vertical thickness of the source
u: groundwater velocity (pore water velocity); u=Ki/θe
K: hydraulic conductivity
i: groundwater head gradient
θe: effective porosity
λ: first order decay coefficient, chemical specific
αx, αy, αz: dispersivities in the x, y and z directions, respectively

For the following lists of parameters, one of three is required: site-specific measurements, defaults or the option of either (which means the default may be used or replaced with a site-specific measurement).

Soil parameters

Parameter		Default Value	Required
ρ_s	soil bulk density	1.86 g/cm^3	option
f_{oc}	fraction organic carbon in the soil	0.01 kg-C/kg-soil	option
θ_T	total soil porosity	0.3 cm^3-voids/cm^3-soil	option
θ_{as}	volumetric air content in vadose zone	0.2 cm^3-air/cm^3-soil	default
θ_{ws}	volumetric water content in vadose zone	0.1 cm^3-H_2O/cm^3-soil	default
θ_{acrack}	volumetric air content in foundation/wall cracks	0.2 cm^3-air/cm^3-soil	default
θ_{wcrack}	volumetric water content in foundation/wall cracks	0.1 cm^3-H_2O/cm^3-soil	default
I	infiltration rate of water through soil	7 cm/year	default

If the total porosity is measured, assume 1/3 is air filled and 2/3 is water filled for determining the water and air fraction in the vadose zone soil and floor cracks.

Groundwater Transport Modeling Parameters

Parameter		Default Value	Required
K	hydraulic conductivity	16060 cm/year	site-specific
i	groundwater head gradient	0.01 cm/cm	site-specific
S_w	width of the source	use procedure specified in 135.10(2)	site-specific
S_d	vertical thickness of the source	3 m	default
αx	dispersivity in the x direction	0.1x	default
αy	dispersivity in the y direction	0.33αx	default
αz	dispersivity in the z direction	0.05αx	default
θe	effective porosity	0.1	default

where u=Ki/θe

Groundwater Transport Modeling Parameters (continued)
First-order Decay Coefficients

Chemical	Default Value λ (d-1)	Required
Benzene	0.0005	default
Toluene	0.0007	default
Ethylbenzene	0.00013	default
Xylenes	0.0005	default
Naphthalene	0.00013	default
Benzo(a)pyrene	0	default
Benz(a)anthracene	0	default
Chrysene	0	default

Other Parameters for Groundwater Vapor to Enclosed Space

Parameter		Default Value	Required
Lgw	depth to groundwater from the enclosed space foundation	1 cm	option
L_B	enclosed space volume/infiltration area ratio	200 cm	option
ER (s-1)	enclosed space air exchange rate	0.00014	default
Lcrack	enclosed space foundation or wall thickness	15 cm	default
η	areal fraction of cracks in foundation/wall	0.01	default

Other Parameters for Soil Vapor to Enclosed Space

Parameter		Default Value	Required
L_S	depth to subsurface soil sources from the enclosed space foundation	1 cm	option
L_B	enclosed space volume/infiltration area ratio	250 cm *	option
ER (s-1)	enclosed space air exchange rate	0.000185 *	default
Lcrack	enclosed space foundation or wall thickness	15 cm	default
η	areal fraction of cracks in foundation/wall	0.01	default

*These values are an average of residential and nonresidential factors.

Soil Leaching to Groundwater

Parameter		Default Value	Required
δ	groundwater mixing zone	2 m	default

Building Parameters for Iowa Tier 2

Parameter		Residential	Nonresidential
ER (s-1)	enclosed space air exchange rate	0.00014	0.00023
L_B	enclosed space volume/infiltration area ratio	200 cm	300 cm

<u>Other Parameters</u>
For Tier 2, the following are the same as Tier 1 values (refer to Appendix A): chemical-specific parameters, slope factors and reference doses, and exposure factors (except for those listed below).

Exposure Factors for Tier 2 Groundwater Vapor to Enclosed Space Modeling:
Potential Residential: use residential exposure and residential building parameters.
Potential Nonresidential: use nonresidential exposure and nonresidential building parameters.

Diesel and Waste Oil

Diesel and Waste Oil			Chemical-Specific Values for Tier 1			
Media	Exposure Pathway	Receptor	Naphthalene	Benzo(a) pyrene	Benz(a) anthracene	Chrysene
Groundwater (ug/L)	Groundwater Ingestion	actual	150	0.012	0.12	1.2
		potential	150	1.2	12.0	NA
	Groundwater Vapor to Enclosed Space	all	4,440	NA	NA	NA
	Groundwater to Plastic Water Line	all	150	1.2	12.0	NA
	Surface Water	all	150	1.2	12.0	NA
Soil (mg/kg)	Soil Leaching to Groundwater	all	7.6	NA	NA	NA
	Soil Vapor to Enclosed Space	all	95	NA	NA	NA
	Soil to Plastic Water Line	all	21	NA	NA	NA

Due to difficulties with analytical methods for the four individual chemicals listed in the above table, Total Extractable Hydrocarbon (TEH) default values were calculated for each chemical, using the assumption that diesel contains 0.2% napthalene, 0.001% benzo(a)pyrene, 0.001% benz(a)anthracene, and 0.001% chrysene. Resulting TEH Default Values are shown in the following table.

Diesel			TEH Default Values			
Media	Exposure Pathway	Receptor	Naphthalene	Benzo(a) pyrene	Benz(a) anthracene	Chrysene
Groundwater (ug/L)	Groundwater Ingestion	actual	75,000	1,200	12,000	120,000
		potential	75,000	120,000	1,200,000	NA
	Groundwater Vapor to Enclosed Space	all	2,200,000	NA	NA	NA
	Groundwater to Plastic Water Line	all	75,000	120,000	1,200,000	NA
	Surface Water	all	75,000	120,000	1,200,000	NA
Soil (mg/kg)	Soil Leaching to Groundwater	all	3,800	NA	NA	NA
	Soil Vapor to Enclosed Space	all	47,500	NA	NA	NA
	Soil to Plastic Water Line	all	10,500	NA	NA	NA

The lowest TEH default value for each pathway (shown as a shaded box) was used in the Tier 1 Table.

Due to difficulties with analytical methods for the four individual chemicals, Total Extractable Hydrocarbon (TEH) default values were calculated for each chemical, using the assumption that waste oil contains no naphthalene, 0.003% benzo(a)pyrene, 0.003% benz(a)anthracene, and 0.003% chrysene. Resulting TEH Default Values are shown in the following table.

Waste Oil			TEH Default Values			
Media	Exposure Pathway	Receptor	Naphthalene	Benzo(a) pyrene	Benz(a) anthracene	Chrysene
Groundwater (ug/L)	Groundwater Ingestion	actual	NA	400	4,000	40,000
		potential	NA	40,000	400,000	NA
Groundwater (ug/L)	Groundwater Vapor to Enclosed Space	all	NA	NA	NA	NA
	Groundwater to Plastic Water Line	all	NA	40,000	400,000	NA
	Surface Water	all	NA	40,000	400,000	NA
Soil (mg/kg)	Soil Leaching to Groundwater	all	NA	NA	NA	NA
	Soil Vapor to Enclosed Space	all	NA	NA	NA	NA
	Soil to Plastic Water Line	all	NA	NA	NA	NA

The lowest TEH default value for each pathway (shown as a shaded box) was used in the Tier 1 Table.

APPENDIX C

DECLARATION OF RESTRICTIVE COVENANTS

Rescinded IAB 7/19/06, effective 8/23/06

APPENDIX D

IOWA DEPARTMENT OF NATURAL RESOURCES

NO FURTHER ACTION CERTIFICATE

This document certifies that the referenced underground storage tank site has been classified by the Iowa Department of Natural Resources (IDNR) as "no action required" as provided in the 1995 Iowa Code Supplement 455B.474(1)"h"(1). This certificate may be recorded as provided by law.

ISSUED TO: OWNERS/OPERATORS OF TANKS
DATE OF ISSUANCE:
IDNR FILE REFERENCES: LUST # REGISTRATION #
LEGAL DESCRIPTION OF UNDERGROUND STORAGE TANK SITE:

Issuance of this certificate does not preclude the IDNR from requiring further corrective action due to new releases and is based on the information available to date. The department is precluded from requiring additional corrective action solely because governmental action standards are changed. See 1995 Iowa Code Supplement 455B.474(1)"h"(1).

This certificate does not constitute a warranty or a representation of any kind to any person as to the environmental condition, marketability or value of the above referenced property other than that certification required by 1995 Iowa Code Supplement 455B.474(1)"h".

These rules are intended to implement Iowa Code sections 455B.304, 455B.424 and 455B.474.

[Filed emergency 9/20/85—published 10/9/85, effective 9/20/85]
[Filed emergency 11/14/86—published 12/3/86, effective 12/3/86]
[Filed emergency 12/29/86—published 1/14/87, effective 1/14/87]
[Filed 5/1/87, Notice 1/14/87—published 5/20/87, effective 7/15/87*]
[Filed emergency 9/22/87—published 10/21/87, effective 9/22/87]
[Filed 2/19/88, Notice 11/18/87—published 3/9/88, effective 4/13/88]
[Filed emergency 10/24/88—published 11/16/88, effective 10/24/88]
[Filed 7/21/89, Notice 2/22/89—published 8/9/89, effective 9/13/89]
[Filed emergency 8/25/89—published 9/20/89, effective 8/25/89]
[Filed 8/31/90, Notice 3/21/90—published 9/19/90, effective 10/24/90]
[Filed 2/1/91, Notice 11/14/90—published 2/20/91, effective 3/27/91]
[Filed emergency 3/29/91—published 4/17/91, effective 3/29/91]
[Filed emergency 8/28/91—published 9/18/91, effective 8/28/91]
[Filed emergency 2/21/92 after Notice 9/18/91—published 3/18/92, effective 2/21/92]
[Filed 9/24/93, Notice 3/17/93—published 10/13/93, effective 11/17/93]
[Filed 12/1/95, Notice 8/16/95—published 12/20/95, effective 1/24/96]
[Filed emergency 6/25/96—published 7/17/96, effective 8/15/96]
[Filed emergency 12/20/96 after Notice 7/17/96—published 1/15/97, effective 12/20/96]
[Filed emergency 6/25/99—published 7/14/99, effective 7/1/99]
[Filed 10/1/99, Notice 7/14/99—published 10/20/99, effective 11/24/99]
[Filed emergency 9/29/00—published 10/18/00, effective 9/29/00]
[Filed 1/19/01, Notice 10/18/00—published 2/7/01, effective 3/14/01]
[Filed 12/19/01, Notice 10/17/01—published 1/9/02, effective 2/13/02]
[Filed 3/23/06, Notice 11/9/05—published 4/12/06, effective 5/17/06]
[Filed 6/28/06, Notice 3/15/06—published 7/19/06, effective 8/23/06]
[Filed emergency 7/6/07—published 8/1/07, effective 7/6/07]
[Filed 10/4/07, Notice 8/1/07—published 10/24/07, effective 11/28/07]

*Effective date of 135.9(4) delayed 70 days by Administrative Rules Review Committee at its June 1987 meeting.